PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Improvements in and relating to Electric Motors

We, MICHAEL SURJANINOFF, and MARIA SURJANINOFF, both of 112, Hauptstrasse, Stammersdorf, near Vienna, Austria, both Russian citizens, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement :—

The invention relates to electric motors of the type wherein the chamber enclosing the stator core with its winding is separated from the chamber enclosing the rotor by a bush or sleeve which hereinafter will be called the gap-sleeve and wherein the stator core with its winding is surrounded by and hermetically sealed within a gas-tight or liquid-tight enclosure, whereas the rotor which is an induction rotor, preferably of the squirrel-cage type, and which is rotatably mounted within a hollow space or bore formed by the wall of the stator chamber, is submerged in a liquid or surrounded by a gas, which is not the same as that contained within the stator chamber.

Serious difficulties have been encountered with gap-sleeves because their thickness must be very small. If made of insulating material their strength will be insufficient to meet the requirements. If however the gap-sleeve is made of metal the motor will suffer from additional eddy-current losses which mean poor efficiency and efficacious water cooling will be needed.

In order to reduce losses it has already been proposed to construct the gap-sleeve by piling up annular pieces of sheet-iron spaced apart by insulating sheets. Exceedingly careful work is required in manufacturing motors of this type in which the iron sheets are continuously forced together under strong pressure and in which even a very small quantity of dirt upon the jointing surfaces is capable of seriously impairing the tightness of the enclosure surrounding the stator with its winding.

It has also been proposed to use a cylindrical sheath of electrically non-conducting material with which is incorporated magnetic material which may be wound in the form of cotton covered iron wire of small section.

An object of the invention is to provide a motor of the above mentioned type with a gap-sleeve which has sufficient strength, is impermeable and causes low eddy-current losses.

According to the invention the gap-sleeve is composed of a mixture of finely divided magnetic material with an insulating binder and this mixture is shaped by moulding or by pressing after having been subjected to appropriate chemical or mechanical treatment or both so as to form a compact and solid body. The magnetic field in the gap between the stator and the rotor which penetrates this sleeve will then rotate without causing substantial eddy-current losses.

Another object of the invention is to further improve the electromagnetic properites of a motor of the above mentioned type and to obtain a similar performance as would be the case if the teeth of the stator were elongated to penetrate across the gap-sleeve.

According to a further feature of the invention the magnetic material such as iron powder or the like is substantially arranged only in the parts of the gap-sleeve which are situated opposite the teeth of the iron core of the stator. In this way the permeability of the gap-sleeve varies over its circumference.

Although the slots are closed by the gap-sleeve a motor built on these lines will in every respect work like a motor with semi-open slots.

A further object of the invention is to reduce the coil-head leakage-flux of motors having an iron containing gap-sleeve. No or practically no magnetic material is arranged in the gap-sleeve where it extends outside the stator bore. A subsidiary feature of the invention consists in varying the percentage of magnetic material and therefore the permeability of the gap-sleeve over its length.

The gap-sleeve may be sufficiently enlarged at the ends of the stator in order to easily obtain close tightening, wherein up to now serious difficulties have been encountered with every known type of motors fitted with gap-sleeves. This enlarged gap-sleeve is especially suitable for motors which are subjected to the influence of iron corroding gases and liquids, the iron

core and its teeth at the surface of the bore being protected by the gap-sleeve.

The invention is illustrated by way of example in the accompanying drawings wherein:

Fig. 1 is a vertical sectional elevation on the line A—C of Fig. 5 of a motor showing the improved gap-sleeve;

Figs. 2 and 3 are vertical sectional elevations of different motors showing modifications of the gap-sleeve and corresponding motor arrangements;

Fig. 4 is a section on the line A—B of Fig. 5;

Fig. 5 is a horizontal section on the line C—D of Fig. 4.

Referring to the drawings wherein like characters of reference indicate like parts, the motor consists of a stator 1 and a rotor 2 with the interposed gap-sleeve 3 mounted in gas- or liquid-tight connection with the stator laminæ 1 or with the casing 4 of the motor, the stator winding 12 being enclosed on all sides and protected against the influence of the surrounding external fluid. The gap-sleeve 3 is composed of a mixture of finely divided magnetic material, for instance iron powder, cast-iron powder or the like and a suitable binder such as cement, artificial resin or the like. In accordance with the quality of the mixture the matter is condensed by pressure or by chemical or thermal influence according to processes and methods adapted to the respective mixture, so as to form a compact and solid body, and the matter is hardened as may be required.

In small motors, as shown in Fig. 1, the gap sleeve may be made integral with the bearing bracket 5, which is tightly joined to the casing 4 of the stator packet 1. The opposite bearing bracket 6 is made separately and tightly joined to the gap-sleeve and to the casing in order to avoid difficulties in winding the stator. The connecting cable 15 is tightly inserted into one of the bearing brackets 5, 6 or front covers of the motor.

In motors of a larger size the shaft 21 may be supported by a separate part 22, as shown in Fig. 2. The end parts 6 (Fig. 1), 8 (Fig. 2), 9 (Fig. 3), and 7 (Fig. 4) of the enclosure in normal cases yield sufficiently to permit dilatation due to heat. The dilation moreover may be allowed for by a resilient packing 10 made of rubber or the like.

In certain cases, where the mixture is composed of a bendable substance similar to rubber, the gap-sleeve 3 may be manufactured with its other flange 11 suitable for direct connection to the casing as in Fig. 2, or, as shown in Fig. 3, separated from the latter. The gap-sleeve as a whole is hardened from a semi-manufactured yielding state in its position on the stator after the latter has been wound so as to form a kind of hard-rubber.

Fig. 4 shows a modification which is adapted for motors with considerable longitudinal dimension, and in which the gap-sleeve is mounted in water-tight connection with the other parts of the enclosure.

The mechanical strength of the gap-sleeve may be increased by admixing fibrous substances and enlarging the sleeve at the end parts. As the gap-sleeve is sufficiently strong in itself, it may be connected preliminarily with a bearing bracket 7 or with a front cover 14 according to Fig. 4 in a liquid-tight manner and mounted on the stator later. The other end is then tightly connected with the reamining parts of the enclosure.

Motors provided with gap-sleeves are subjected to considerable slot-leakage. To avoid this the gap-sleeve is made with varying iron percentage, as shown in Figs. 1, 4 and 5 (on the right hand side thereof) in such a manner, that the reluctance of the leakage paths is increased by arranging parts 16 containing few iron particles in or near the slot mouths. The gap-sleeve may be made with ribs projecting into the openings of the slots, whereby mechanical strength is increased and coil winding is made easier. The admixture of iron is shown in Figs. 4 and 5 by different dotting. As the parts 16 of the gap-sleeve 3, which are situated opposite the openings of the slots, are free of iron or at least containing much less of it over their whole length than parts 17, a greater proportion of the magnetic field is led into the rotor and magnetic leakage thereby is reduced. The motor as described, having in fact slots equivalent to closed slots, shows all the distinctive features of the motors with open slots. It is therefore possible to design the gap-sleeve considerably thicker than it has been up to now in known types of motors. This fact moreover permits of fitting the gap-sleeve with a thread 20 or the like and in consequence follows a simplified tightening.

As may be seen from Figs. 1, 2, 3 and 4, no or practically no magnetic material is arranged in the gap-sleeve where it extends outside of the stator bore. The coil-head leakage-flux, which otherwise would establish itself as a considerable but useless magnetic field with additional losses within the gap-sleeve is reduced to the same value which it usually has in normal motors of the standard type.

The end chambers 18 may be filled by way of the opening 19 with an insulating compound, paraffin or the like in a liquid state and the insulation of the conductors within the slots thereby is improved. Part of the chamber remains filled with air

admitting dilation by heat.

The motor is preferably made with semi-open slots in order to obtain cheaper winding. The gap-sleeve may be inserted after winding or may be manufactured on the stator. As the jointing parts are manufactured and tested by mechanical means the invention permits of the production of very cheap and reliable motors for refrigerating plants and of motors working submerged in a liquid and for similar purposes.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is :—

1. An electric motor with a gas-tight or fluid-tight stator and provided with an air gap-sleeve thereby characterised, that the gap-sleeve is composed of a mixture of finely divided magnetic material with an insulating binder.

2. An electric motor according to claim 1, thereby characterised, that the iron percentage of the gap-sleeve is greater opposite the stator teeth than opposite the openings of the slots.

3. An electric motor according to claim 1 or 2, thereby characterised, that the portions of the gap-sleeve situated outside of the stator core and its flange portions are free or neatly free of iron.

4. An electric motor according to claim 1, thereby characterised, that the gap-sleeve is provided with a flange covering the winding at one end.

5. An electric motor according to claim 1, thereby characterised, that the gap-sleeve is provided with yielding flanges at both ends, these flanges covering the winding on both ends of the stator.

6. An electric motor according to claim 1 or 2, thereby characterised, that one bearing bracket is integral with the gap-sleeve.

7. A method of manufacturing an electric motor according to any of the preceding claims, thereby characterised, that the gap-sleeve joined with one end cover is first mounted on the stator and then is connected with the other end member, whereafter the whole is enlosed in an air-tight or fluid-tight manner.

8. An electric motor constructed, arranged and adapted to operate substantially as hereinbefore described with reference to the accompanying drawings.

Dated this 13th day of October, 1937.

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Fig.1

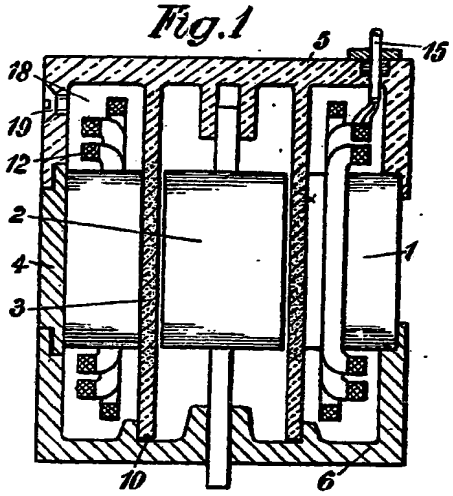


Fig.4

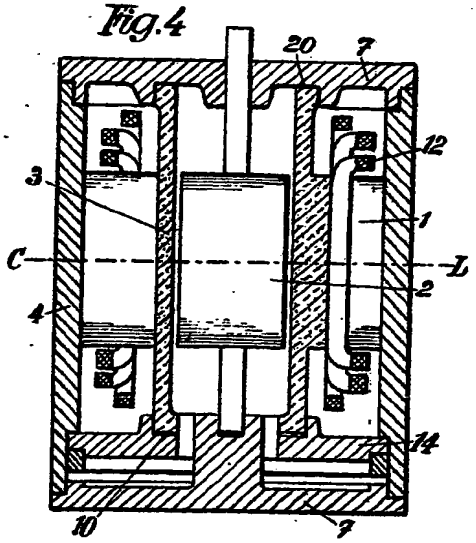


Fig.2

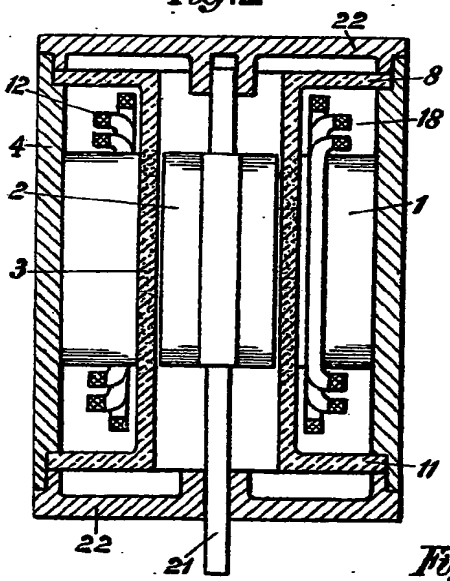


Fig.5

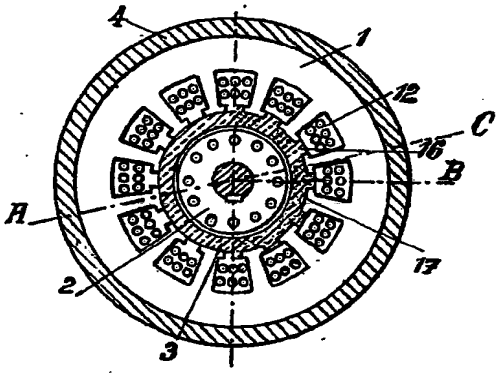
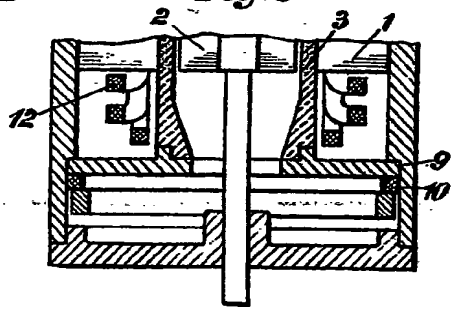


Fig.3



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